MOTT MACDONALD

EIRGRID

Step 4B Consultant's Development Options Report

Celtic Interconnector Project

November 2020

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Contents

Tables

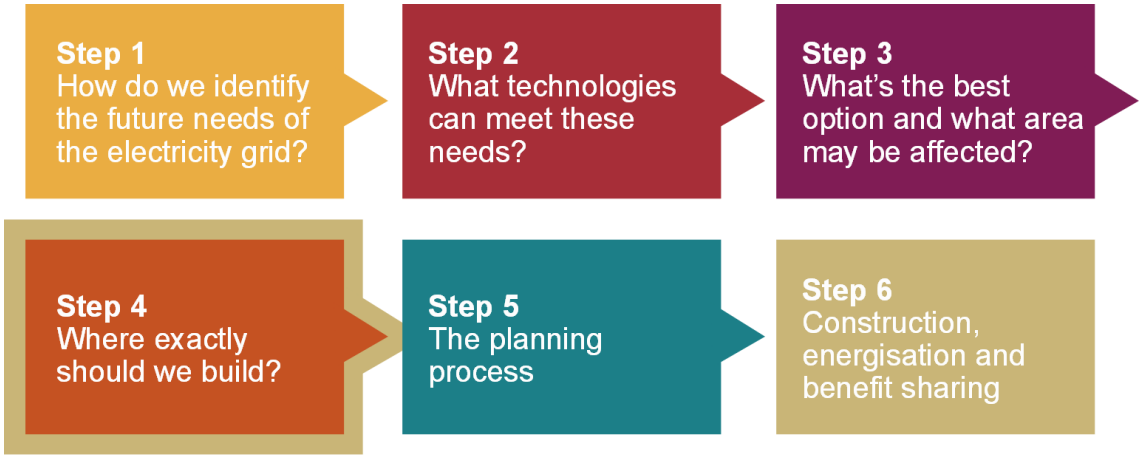
Figures

Executive Summary

The proposed Celtic Interconnector project will create a direct electricity link between Ireland and France. It is being developed by EirGrid, the electricity transmission system operator in Ireland, and its French counterpart, RTE (Réseau de Transport d'Électricité).

In accordance with EirGrid's bespoke six-step Framework for Grid Development, the Irish onshore elements of the Project are currently in Step 4, where the development proposals are defined.

EirGrid's Six-Step Framework for Grid Development



Source: EirGrid

A detailed analysis of options, and feedback received on those options has been assessed in this report. Based on this information and details gathered from further studies, it is EirGrid's intention to progress to Step 5 (the planning process) for the development of the Irish elements of the Celtic Interconnector project based on the following identified Best Performing Options (BPOs):

- A landfall point where a submarine cable (connecting approximately 500km of submarine cable between France and Ireland) will come onshore and connect with an onshore underground cable, at a location to the north-west of the car park at Claycastle Beach;
- A High Voltage Direct Current (HVDC) underground cable between the landfall point and a converter station at the IDA owned lands at Ballyadam, east of Carrigtwohill, Co. Cork;
- A converter station, to convert the electricity from HVDC to High Voltage Alternating Current (HVAC), which is used on the Irish transmission grid and vice versa;
- A HVAC underground cable between the converter station at Ballyadam, and the connection point on the transmission grid at Knockraha 220 kV substation in County Cork.

The BPOs are presented in Appendix B *Best Performing Options* of this report. References are included in Appendix A *References*.

An application for statutory approval to the Strategic Infrastructure Development (SID) Division of An Bord Pleanála (ABP) and a Foreshore Licence Application to the Foreshore Unit of the

Department of Housing, Local Government and Heritage (DHLGH) will now be prepared for the BPOs identified in this report.

The application to ABP will relate to works within and between Knockraha 220 kV substation and the ordinary high water mark at Claycastle Beach.

The application to the Foreshore Unit of the DHLGH will relate to works between the ordinary high water mark at Claycastle Beach and the twelve nautical miles limit (twelve nautical miles is appropriately 22.24km).

Both applications will be supported by an Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement (NIS).

It is anticipated that the applications will be submitted in Spring 2021.

1 Introduction

1.1 The Project

The Celtic Interconnector project will create a direct electrical interconnection between Ireland and France to allow the exchange of electricity between the two countries. It is being developed by EirGrid, the electricity transmission system operator in Ireland, and its French counterpart, RTE (Réseau de Transport d'Électricité).

The Celtic Interconnector is being developed in response to European challenges such as the energy transition and the role of energy in the management of climate change. Recognised as a Project of Common Interest (PCI) by the European Union, the project meets the criteria detailed in Article 4 of the EU Regulation 347/2013 on guidelines for trans-European energy infrastructure i.e. the project contributes significantly to at least one of the following specific criteria:

- Market integration, *inter alia*, through lifting the isolation of at least one Member State and reducing energy infrastructure bottlenecks; competition and system flexibility;
- Sustainability, *inter alia*, through the integration of renewable energy into the grid and the transmission of renewable generation to major consumption centres and storage sites; and
- Security of supply, *inter alia*, through interoperability, appropriate connections and secure and reliable system operation.

The Celtic Interconnector will:

- Facilitate an increase in the use of renewable energy
  - An interconnection between Ireland and the continent will increase the integration of renewable energy at the European level and enable France and Ireland to move forward in terms of the energy transition (in line with national policies in respect of the development of renewables).
- Provide security of supply
  - Pooling resources enables countries to better cope with contingencies and spikes in electricity consumption. Interconnection will promote mutual assistance between the two countries and would work in both directions.
- Improve European solidarity on energy
  - The Celtic Interconnector project will be a benchmark project in terms of European Solidarity on energy. It will enable Ireland to benefit directly from the European integrated electricity market. The Celtic Interconnector will be Ireland's only direct transmission link with another Member State of the European Union.
- Promote the movement of electricity flows at a European level
  - By promoting the movement of electricity in Ireland, in France and throughout all of continental Europe, the Celtic Interconnector will enable European consumers to benefit from a more open electricity market.
- Support the development of a more sustainable electricity mix in France and in Ireland
  - The Celtic Interconnector will contribute to the European objectives of a low-carbon energy future, promoting the development of other renewable energy sources and their integration into the European electricity system.

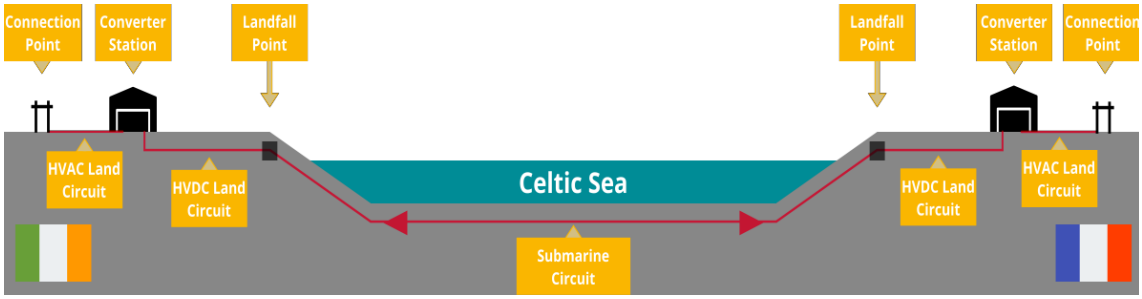
In this context, the project enjoys strong support from both the French and Irish governments, as well as from the European Commission. Of particular note in this regard, the completion of the project is specifically included in the current Irish Programme for Government.

The main elements of the Celtic Interconnector in Ireland comprise:

- That portion of a High Voltage Direct Current (HVDC) submarine circuit within Irish Territorial Waters (TW) and the Irish Exclusive Economic Zone (EEZ). The portion within the Irish TW is approximately 34km and the portion within the Irish EEZ is approximately 117km in length. The overall subsea cable between Ireland and France is approximately 497km in length, placed on or beneath the seabed;
- A landfall location where the submarine circuit comes onshore, at Claycastle Beach, Youghal in County Cork. This landfall was previously identified as the Emerging Best Performing Option (EBPO) in the Step 4A Consultant's Development Options Report (Mott MacDonald, November 2019;
- A HVDC underground cable circuit between the landfall point and a converter station;
- A converter station, to convert the electricity from HVDC to High Voltage Alternating Current (HVAC), which is used on the Irish transmission grid and vice versa;
- A HVAC underground cable circuit between the converter station and the connection point on the transmission grid; and
- Associated works within the connection point on the transmission grid. This has previously been confirmed as being located at Knockraha 220 kV substation in County Cork.

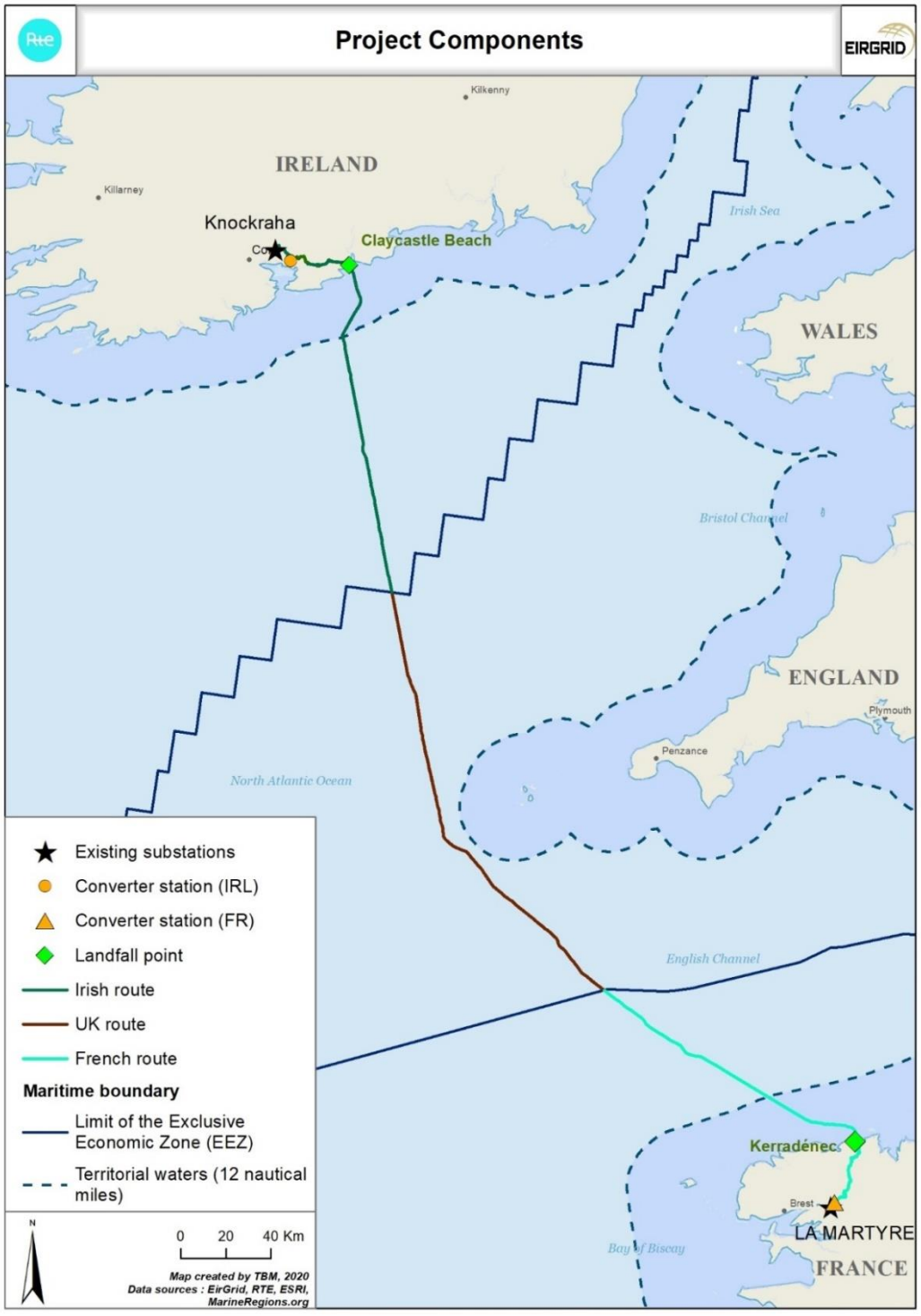
An overview of the key elements of the project is illustrated in Figure 1.1 and Figure 1.2.

Figure 1.1: Celtic Interconnector (Overview of Project Elements)



Source: EirGrid

Figure 1.2: Overview of the Entire Route of the Celtic Interconnector

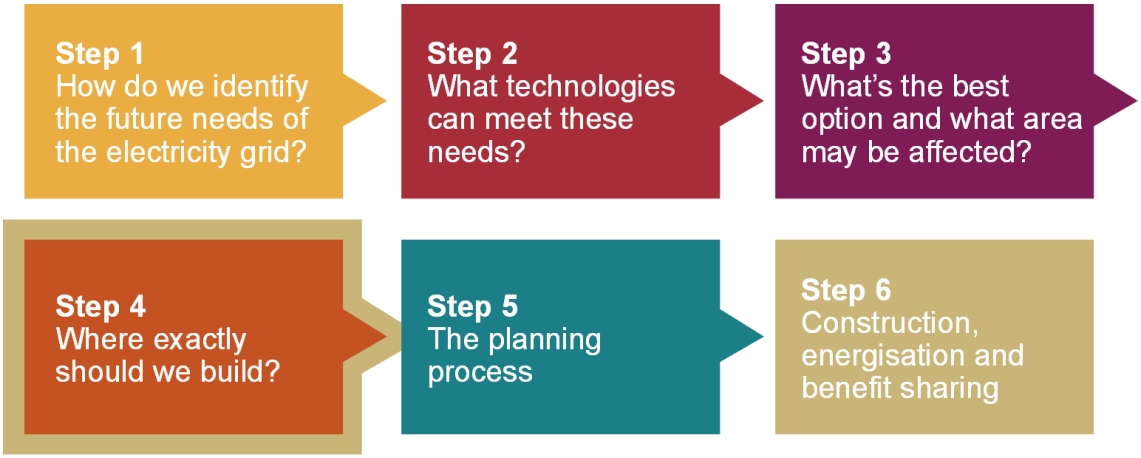


Source: EirGrid and RTE

1.2 Purpose of this Report

The Project in Ireland has been and continues to be developed in accordance with EirGrid's bespoke six-step Framework for Grid Development. This framework reflects EirGrid's values and approach to grid development. The Project is currently in Step 4 as presented in Figure 1.3. In accordance with EirGrid's Framework, a detailed analysis of feedback received has been central to the grid development process.

Figure 1.3: EirGrid's Six-Step Framework for Grid Development



Source: EirGrid

As a result of the assessment process, additional technical and environmental studies have been undertaken along with ongoing engagement and these have informed the identification of the BPO.

It is intended to submit the Irish consent applications for the Celtic Interconnector project in Spring 2021.

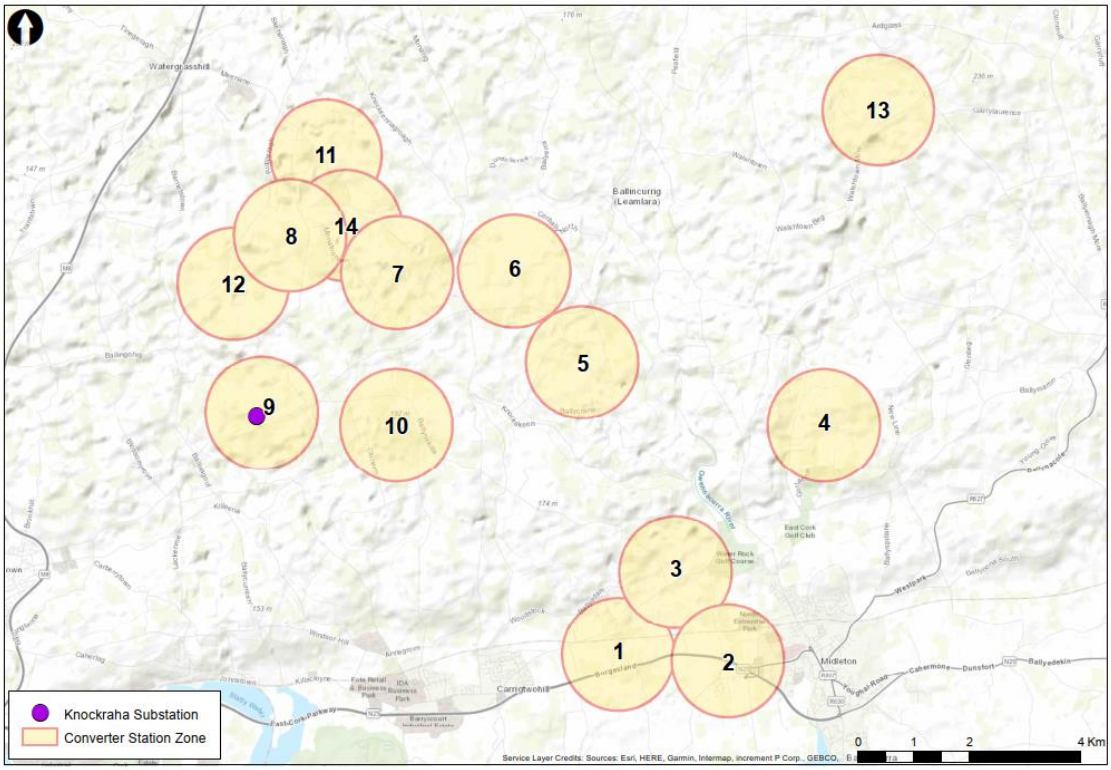
2 Identification of the Best Performing Option (Converter Station Site)

2.1 Background to the Identification of the Emerging Best Performing Options

This section provides an outline summary of the process and deliverables resulting in the identification of the Emerging Best Performing Options (EBPOs).

The Step 3 Onshore Constraints Report (Mott MacDonald, April 2019) presented baseline information on identified onshore constraints associated with 14 Converter Station Location Zones (CSLZs). Each CSLZ represented an area approximately 2km in diameter, as illustrated in Figure 2.1.

Figure 2.1: Step 3 Onshore Constraints Report CSLZs



Source: Mott MacDonald

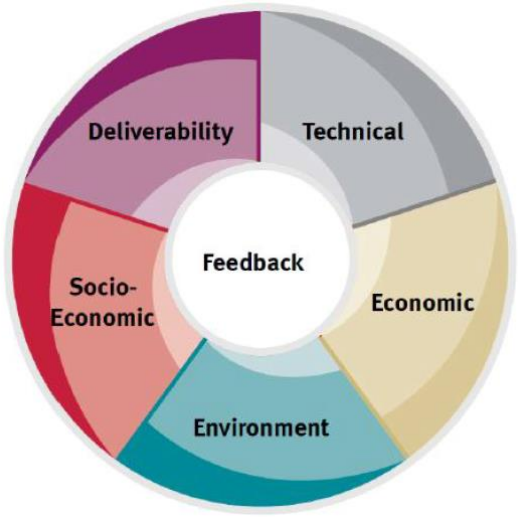
The Step 3 - Performance Matrix Assessments (EirGrid, Spring 2019) provided a comparative evaluation of the CSLZs identified in the Step 3 Onshore Constraints Report (Mott MacDonald, April 2019) against the set of criteria illustrated in Figure 2.2.

The following short-list of six CSLZs was subsequently confirmed:

- CSLZ 1 Ballyadam
- CSLZ 6 Leamlara
- CSLZ 9 Knockraha

- CSLZ 10 Pigeon Hill
- CSLZ 12 Kilquane
- CSLZ 14 Ballyvatta

Figure 2.2: EirGrid's Assessment Criteria



Source: EirGrid

The Step 3 Preferred Options Report (Mott MacDonald, August 2019) documented the Step 3 consultations undertaken and the feedback received in the context of the shortlist of six CSLZs.

The Step 4A Consultant's Development Options Report (Mott MacDonald, November 2019), presented an analysis of the six shortlisted CSLZs identifying at least one potential converter station site (CSS) within each of the CSLZs, as follows:

- CSS 1 Ballyadam
- CSS 6 Leamlara
- CSS 9A Knockraha
- CSS 9B Knockraha
- CSS 10 Pigeon Hill
- CSS 12 Kilquane (Meeleen)
- CSS 14 Ballyvatta

A comparative evaluation of the above referenced CSSs was presented against the criteria illustrated in Figure 2.2.

The Step 4A Consultant's Development Options Report concluded that CSS 12 (Kilquane / Meeleen) would be brought forward as the EBPO to Step 4B and further consideration would also be given to both CSS 1 (Ballyadam) and CSS 9B (Knockraha) at Step 4B. It stated that further assessment would be required on the shortlisted sites prior to the identification of the Best Performing Option (BPO) for the project. Public consultation occurred between 11 November 2019 and 2 February 2020 as outlined in the Step 4 Project Update Document (EirGrid, Spring 2020).

CSS 12 comprises agricultural lands in a rural setting which were, at that time, identified by EirGrid and its consultants (Mott MacDonald) to be the Emerging Best Performing Option (EBPO) primarily due to the substantial visual screening that an area of commercial forestry and surrounding topography offered from nearby roads and residences, and the relative accessibility of the site for both the HVDC and HVAC cable routes.

CSS 9B comprises agricultural lands adjacent to the existing Knockraha substation; consequently, these performed best under both environmental and economic criteria.

CSS 1 is located at an edge-of-urban area, in a relatively unpopulated location, on lands zoned for industrial development, and adjacent to the noise-inducing N25 National road corridor. It is the site of a previously permitted major industrial development (no longer being progressed), and in the ownership of the Industrial Development Authority (IDA). This site was advocated by a variety of stakeholders as a potentially appropriate site for the siting of the converter station.

The following sections of this chapter sets out the analysis undertaken in respect of the above referenced sites, community and other feedback received from EirGrid's Step 4 consultation process, as detailed in the Step 4 Consultation Report (Traverse, April 2020) and in Section 2.2 *Consultation Feedback* below, and studies that have been carried out subsequent to the publication of the Step 4 Project Update Document, as detailed in Section 2.3 *Overview of EBPOs for the Siting of a Converter Station*.

2.2 Consultation Feedback

2.2.1 Step 4A Consultation

The purpose of consultation at Step 4 of the EirGrid six Step Framework for Grid Development process is to gather feedback that can significantly influence exactly where a project is built. In Step 4, EirGrid's aim is to work closely with local people, to understand how a project can affect the local environment and how it might be designed to minimise this impact. The process is used to learn about local factors and to commence a collaborative way of working on the development of an established project plan. Consultation feedback influences the detail of where and how we build an agreed solution.

The Step 4A consultation sought feedback on the assessments that had previously been carried out, the identified landfall location at Claycastle Beach, the three sites identified for the converter station, the underground cable routes, how a community fund could ensure benefits are accrued to the local area, and the consultation process itself.

A comprehensive promotional campaign was carried out to encourage and facilitate participation in the consultation process. Responses to the consultation were submitted via an online form, by email, by post, as well as hardcopy response forms completed during local consultation events, and also delivered by hand directly to EirGrid's office.

In total, this consultation received 1,047 responses.

The Step 4 Consultation Report was prepared by Traverse, an independent consultancy specialising in consultation analysis who had been commissioned by EirGrid Group to analyse responses to the consultation and report on their findings. The report provided a summary of the responses received to the consultation organised by question, the sentiment of their comment, such as benefits, concerns and suggestions, then by theme, such as environmental issues, socio-economic issues, and deliverability.

Key themes to emerge included concerns related to:

- Noise,
- Health and safety,
- Visual impact and light pollution,
- Impact on the community and the community fund,
- Impacts on local water quality,
- Recreational land use, ecology and wildlife,
- History and heritage,
- Traffic and the road network.

Feedback from the consultation process was subsequently incorporated into the ongoing project assessments as communicated in the Step 4 Project Update Document (May 2020) and hence played a significant part in influencing the project's progress and development.

2.2.2 Community Benefit

Feedback was also received on how a community fund can be best applied among East Cork communities associated with the Celtic Interconnector and what support EirGrid could give to ensure its success.

Having considered this feedback it has been agreed that the Celtic Interconnector community fund will be an enhanced scheme that consists of:

- General community grants fund to assist in improving facilities and education for all ages;
- Sustainability fund to support transition to sustainable communities; and
- Biodiversity fund to ensure a net biodiversity contribution resulting from the infrastructure.

EirGrid will confirm the full and enhanced value of the scheme and establish a Celtic Interconnector Community Benefit Steering Group subject to planning permission being granted.

This steering group will lead and shape the community benefit scheme. The group membership will include local community members from the communities impacted by the project. It will be supported by an independent chairperson and a fund administrator.

The funds for the scheme will be released in three phases as milestones are reached – when the construction phase commences; when the underground cables are being installed and; at the commissioning stage. This ensures a long term benefit for Celtic Interconnector Communities.

This enhanced approach to community funding for the Celtic Interconnector project reflects the strategic importance of the project and the impact it will have on Ireland's energy transition to a low carbon energy future. It also reflects EirGrid's ambition to facilitate a greater role for communities in this transition.

2.3 Overview of the EBPOs for the Siting of the Converter Station

The following sections focus on the Step 4A identification of the EBPO for the converter station site, and the relevant information and analysis that has informed the Best Performing Option (BPO) as identified in this Step 4B report.

2.3.1 Converter Station Site 1 Ballyadam

The Ballyadam site is a brownfield site located on property owned by the Industrial Development Authority (IDA) and is commonly referred to as 'the former Amgen site'. It is located between Carrigtwohill and Midleton, to the north of the N25 Cork to Waterford road and south of the Cork to Midleton rail line, as illustrated in Figure 2.3. This ca. 56ha. site is zoned for industry use in the current Cork County Development Plan (2014).

Since the publication of the Step 4 Project Update Document (May 2020), studies and assessments have focused on the Ballyadam site. EirGrid has engaged with the landowner, the IDA, who has identified a potential site for the converter station in the north eastern portion of the overall landholding. This site is adjacent to an area which has been separately identified for development as an electricity distribution substation. As such, this portion of the overall landholding would comprise a concentration of strategic electricity infrastructure, thereby leaving the remainder of the landholding available for other development.

The following is therefore an update to the baseline assessment of the site, as was presented in the Step 4A report.

The site is located approximately 10km by road from the existing Knockraha substation. The nearest residence to the site is located approximately 170m to the north. While the site is proximate to the eastern edge of Carrigtwohill, the actual receiving environment has a small number of sensitive receptors, in the main individual dwelling properties. Undeveloped lands to the north-west and west of the overall IDA landholding at Ballyadam, some considerable distance from the converter station site, are zoned for future residential development in the current Cork County Development Plan (2014).

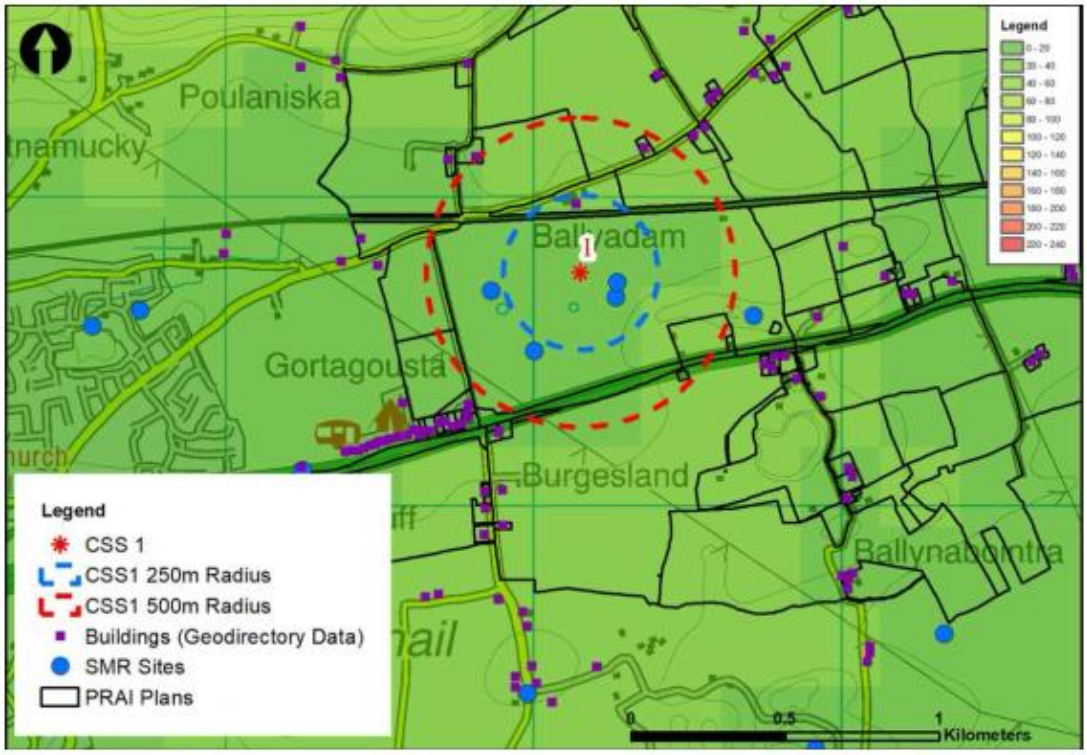
The ground in this area is dominated by karst, i.e. soluble rock. Karst regions typically contain un-mapped underground draining systems with sinkholes and caves. Some 30 known caves have been recorded within approximately 3km of the Ballyadam site. As a result, this site presents considerable design complexity.

To avoid impacting on the sensitive karst rock, development on this site would require a fully sealed drainage system (i.e. no infiltration / discharge to ground) with surface water collected via a combination of downpipes, gullies, and linear channel drains. This water would be discharged to the public network via a pipeline in the south west corner of the site with runoff from the site restricted to pre-development/greenfield runoff rates. The converter station compound would be required to be elevated above current site levels to facilitate the drainage proposal. This would most likely require the importation of fill onto the site.

There are also two depressions within the site. It is understood that these were excavated as part of permitted ground improvement works carried out to facilitate the previous industrial development planned for the overall landholding and were subsequently abandoned between approximately 2007 and 2009. These depressions currently collect rainwater and would be required to be infilled to facilitate the converter station development (or indeed any other development) at this location. An area of compensatory rainwater storage would be required to be created elsewhere on or adjacent to the site to replace this existing storage capacity. This 'cut' arising from creating such a compensatory storage area could potentially be used to partially 'fill' the depressions, subject to geotechnical and ground investigation studies.

A preliminary flood risk assessment of the site has been carried out and it has concluded that the site is not considered to be at risk of flooding from fluvial or coastal sources. The site is not considered to be at risk from ground water sources, although access and egress along the access roads may be at risk. Provided that the site is raised, and the existing depressions are infilled, the site is not considered to be at risk from pluvial sources, although access and egress along the access roads may be at risk.

Figure 2.3: CSS 1 Ballyadam



Source: Step 4A Consultant's Development Options Report

Notes:

- SMR Sites= Sites and Monuments Record Sites i.e. Cultural Heritage Sites
- PRAI Plans = Property Registration Authority Ireland Plans

Suitable mitigation measures in the form of dedicated flood water routing and compensatory storage would therefore need to be designed and constructed to ensure that there is no measurable increase in flood risk.

Any converter station development on the site will be designed in collaboration with the IDA to ensure it successfully and appropriately integrates into a wider development context for the overall landholding. Moreover, the overall consideration of locating the converter station and associated development at this site has had regard to the previous permission (now expired) for industrial development on the overall landholding, which was determined by both Cork County Council and An Bord Pleanála of matters of proper planning and sustainable development.

The identified converter station site location (the north eastern section of the Ballyadam site) comprises a mosaic of habitats closely associated with shallow, well-drained calcareous ground. Within the footprint of the converter station the Near Threatened plant species Greater Knapweed was recorded along with Bee Orchids (a species of Least Concern) and a small localised area of calcareous grassland found to qualify as priority Annex 1 habitat type 6210*. A significant number of Bee Orchids were also recorded within the wider Ballyadam site, which have potential to be impacted by construction activities. A strategy for translocation is therefore being developed as a mitigation measure to accommodate the priority Annex I habitat, Bee Orchids and Near Threatened Greater Knapweed.

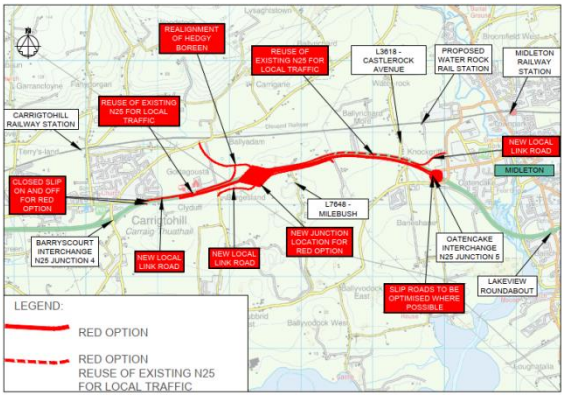
Given its urban setting, the area surrounding the site is likely to be subject to changing land use patterns in the future. Noise mitigation measures would likely be required to ensure that adverse noise impacts from the converter station development are avoided or minimised. The converter station development, however, needs to be understood in terms of the planned evolution of the wider IDA landholding as a location for industrial activity, with associated provision of internal road and drainage infrastructure, and construction of new built form on the site, with associated noise generation and other potential environmental impact.

In addition, and of particular note, the Cork Roads Design Office (RDO) in liaison with Transport Infrastructure Ireland (TII) are currently planning the upgrading of the part of the existing N25 between Carrigtwohill and Midleton, including that portion which adjoins the site. This road project will involve the expansion of the existing road corridor to dual carriageway. A number of potential options affecting the wider IDA landholding at Ballyadam are currently being considered by the RDO, including the provision of a full dumb-bell interchange at Ballyadam, with associated slip roads, which would require to be constructed on the southern portion of the overall landholding. The options are available to view on the N25 Brochure published by Cork County Council's Roads Design Office (RDO) in October 2020. Extracts from the brochure are presented in Figure 2.4 to Figure 2.7.

In summary, the overall IDA lands at Ballyadam, and other lands to the south, north-west and west thereof, are all identified for significant future industrial, residential and infrastructural development. This is an important development context for consideration of the north-eastern portion of the overall landholding as a converter station site for the Celtic Interconnector.

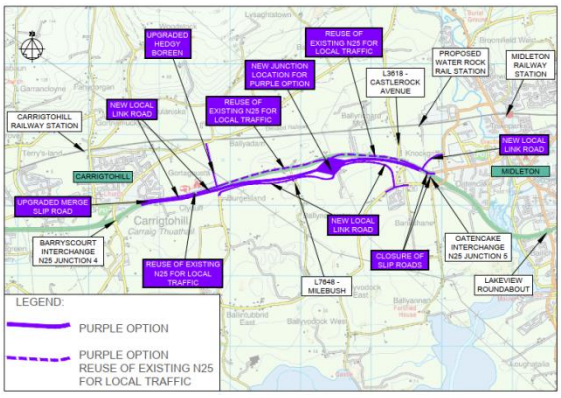
Notwithstanding the development context above, respondents to consultation raised a number of concerns relating to the location of the Celtic Interconnector converter station at the Ballyadam site, including disruption to use of local roads, the karst environment, flooding, visual impacts, noise and the local economy.

Figure 2.4: N25 Carrigtwohill to Midleton Red Route Option



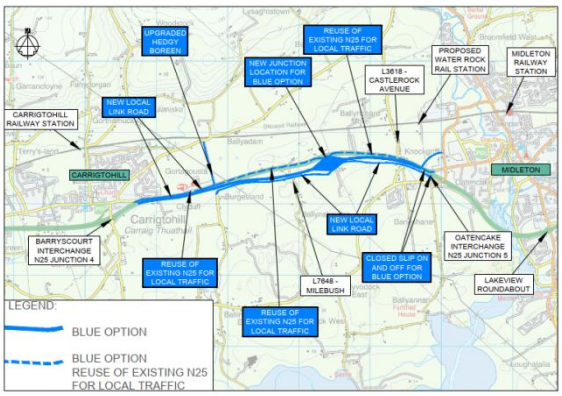
Source: N25 Brochure

Figure 2.5: N25 Carrigtwohill to Midleton Purple Route Option



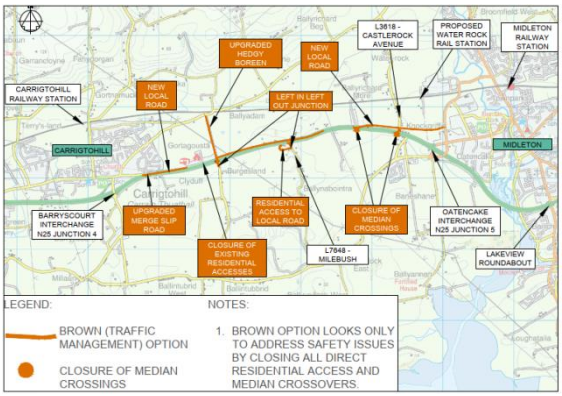
Source: N25 Brochure

Figure 2.6: N25 Carrigtwohill to Midleton Blue Route Option



Source: N25 Brochure

Figure 2.7: N25 Carrigtwohill to Midleton Brown Route Option



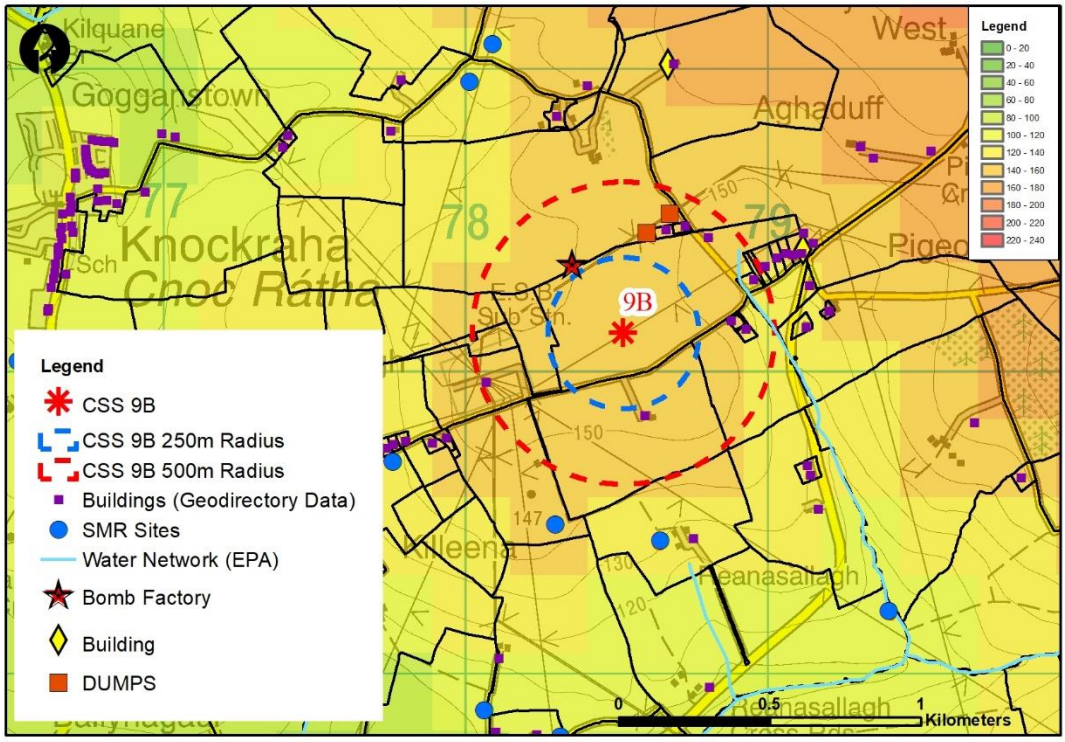
Source: N25 Brochure

2.3.2 Converter Station Site 9B Knockraha

This greenfield site is located adjacent to and east of the existing Knockraha 220 kV substation, on agricultural lands that are in private ownership, as illustrated in Figure 2.8. Given its close proximity to the existing station, certain electrical equipment – known as shunt reactors – would not be needed at this location with this option. These pieces of equipment are only required when there is a more substantial distance between the converter station site and the existing substation. This site is in a rural setting with established electricity transmission infrastructure; however, due to its elevated and exposed location, visual impacts, which cannot be fully mitigated given the scale of the converter station building, are likely. There are five residential properties located within approximately 500m of the centre of the site and the nearest house is approximately 283m north of the site.

Respondents to consultation raised a number of concerns to the Knockraha site including those relating to the scale and extent of existing electricity transmission infrastructure in the area, its rural and generally quiet and unspoilt location, the significant visual impact that a converter station would effect on the receiving environment, noise, biodiversity and community impact.

Figure 2.8: CSS 9B Knockraha



Source: Mott MacDonald

2.3.3 Converter Station Site 12 Kilquane (Meeleen)

This site is located in the townland of Meeleen on privately owned lands to the east of a commercial forest (Kilquane), as illustrated in Figure 2.9. The site, hereafter referred to as Meeleen, is approximately 2km straight line distance north of the existing Knockraha substation.

The short distance between the site and the existing Knockraha substation could facilitate a cross-country route for the HVAC connection. Alternatively, the cable would be installed in the local road network.

The site benefits from a high degree of natural screening due to a combination of the mature commercial forest plantation that backs it to the west and north, and elevated terrain a short distance to the east. There are no properties within 500m of the centre of the site and nine properties within one kilometre.

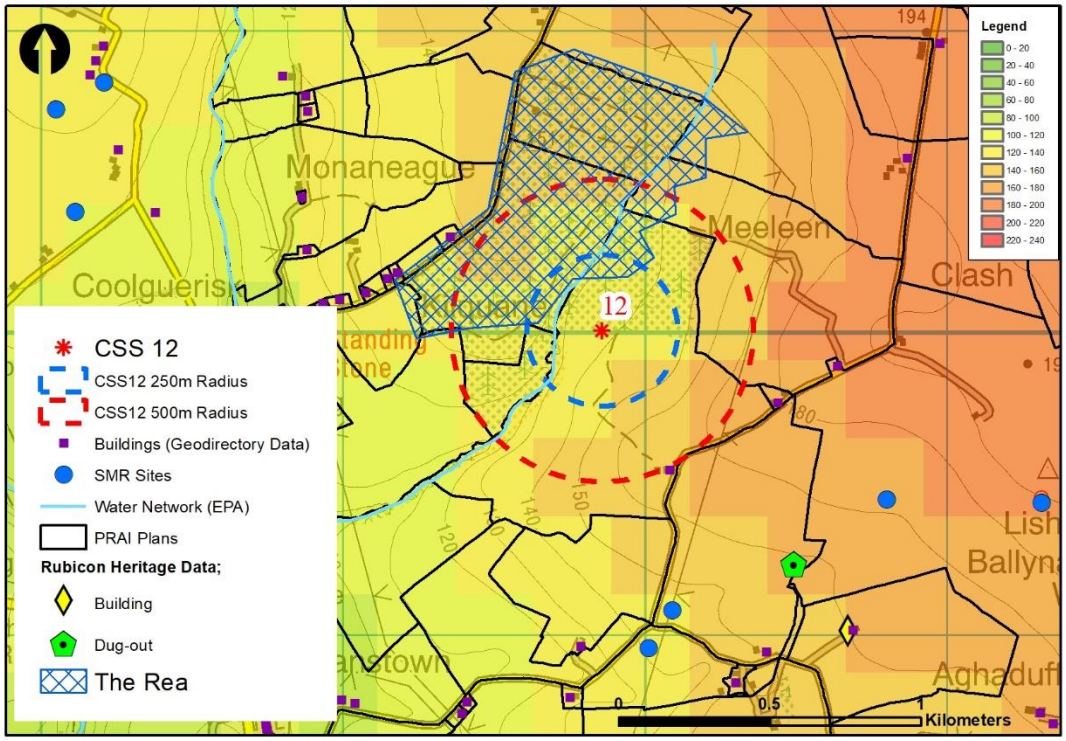
Several respondents to Step 3 consultation referenced *"The Rea"*, an execution site and burial ground within Kilquane forest during the War of Independence, and other historical sites in the areas of Kilquane / Knockraha. The identified converter station site avoids these areas.

Construction access to this site could either be through the forest, or via the local road network. Substantial road upgrades would, however, be required to provide construction access by road.

This site is the furthest distance from residential properties of the three short-listed sites and no significant additional equipment would be required at either end of this cable due to its relatively short length.

Respondents to consultation raised a number of concerns including those in relation to the amount of existing infrastructure in the area, its rural location, access and potential need for road works, visual impacts, potential impacts on cultural heritage and impacts on biodiversity.

Figure 2.9: CSS 12 Kilquane (Meeleen)



Source: Mott MacDonald

2.4 Identification of the BPO for the Siting of the Converter Station

The following section presents a comparative evaluation of the three options against the set of criteria illustrated in Figure 2.2.

2.4.1 Environmental Performance

The Ballyadam site presents a number of issues from an environmental perspective; however, these challenges can be mitigated through the use of engineering solutions. The issues mainly relate to the karst features associated with the site. Studies have concluded that these solutions, whilst resulting in a complex design of development, would avoid those identified issues.

The Ballyadam site is located within an outer-urban area and consequently the surrounding receiving environment is subject to change in terms of its sensitivity. As has been noted, the overall landholding was previously in receipt of permission for industrial development of a scale and extent far exceeding that which would arise for a converter station development. Moreover, the landholding and wider environs are planned to accommodate additional future residential, industrial and infrastructure development; therefore, the converter station strategic infrastructure development will in time be set into an altered development context.

The Knockraha and Meeleen sites generally mitigate such impacts by avoidance, although road upgrades would be required to provide construction phase access to the Meeleen site. Other impacts on the receiving rural environment have however been voiced by the Knockraha and Meeleen communities, particularly in terms of visual impact and the loss of and / or impact upon long-established natural heritage and rural sense of place. The potential for impact upon the cultural heritage of the area, both known and undiscovered, is also of significant concern to these local communities.

2.4.2 Social Performance

The Ballyadam site is considered to perform better than the Knockraha and Meeleen sites from a social perspective. Given its outer-urban setting, and the planned evolving nature and land use of the overall Ballyadam landholding and surrounding environs, the sensitivity of the zone of impact of the converter station at the Ballyadam site is subject to change. This is in contrast to the other two sites whereby the converter station must be considered to comprise a permanent imposition into a quiet rural environmental setting. This, it is considered from feedback arising, will have a negative social impact, particularly for a community that considers it to have already accommodated major electricity transmission infrastructure over the last number of decades, associated with the existing Knockraha substation.

2.4.3 Technical Performance

The only differentiating factor between the three sites in terms of technical performance is the need for additional equipment associated with the Ballyadam option, as a direct result of the distance between the converter station and substation.

Given that both the Knockraha and Meeleen options are located in relatively close proximity to the connection point (Knockraha substation), these sites perform better than the Ballyadam site in terms of technical performance.

2.4.4 Deliverability

Access for construction traffic for Ballyadam and Knockraha is substantially the same given that construction traffic has operated on these roads previously. However, on balance, Ballyadam will perform better in this regard given it has direct access off the N25 National Primary Route.

Substantial road upgrades would be required to provide construction phase access to Meeleen, either through the Kilquane commercial forest which would require the construction of a permanent bridge and potential road widening within the forest or via local roads to the east.

Knockraha and Meeleen are considered to be better performing options than Ballyadam in terms of the HVAC underground cable between the converter station and the transmission substation, given the increased length of HVAC cable from Ballyadam along narrow roads. The Knockraha and Meeleen site also do not have as complex design requirements as Ballyadam in terms of matters such as ground conditions and the need to cross under a live railway line, that are associated with the characteristics of the site.

In terms of overall deliverability there is public understanding of the developmental nature of the IDA owned Ballyadam site. Such understanding has not been expressed for the two other sites considered.

2.4.5 Economic Performance

From an economic perspective, Knockraha and Meeleen are considered to be better performing options, largely due to the increased design complexity associated with development of a

strategic infrastructure development at Ballyadam and the increased length of total HVAC underground cable required to connect Ballyadam and the connection point (Knockraha substation).

2.5 Conclusion

Identification of the Best Performing Option has considered and balanced the five key criteria – technical, economic, environmental, social and deliverability - in respect of the three site options. Site assessments at Ballyadam have confirmed that potential technical and environmental challenges of developing the site for the converter station can be mitigated by appropriate design solutions. In addition, the urban development context for the Ballyadam site is evolving and this contrasts with what is likely to remain a rural development context for the other two options that were considered. This would be most pronounced in terms of the provision of large buildings and electrical apparatus at the converter station, as well as necessary road and other infrastructure required to serve this strategic infrastructure development.

Having reviewed and considered the outcomes of the assessment process from a multi-criteria perspective, the **Ballyadam** site has been identified as the Best Performing Option (BPO) for the converter station. In particular, it performs well from a social and deliverability perspective, while any issues arising in respect of key criteria can be managed by way of technical and site design, and environmental mitigation.

The subsequent sections of this report consider the land circuit (HVAC and HVDC underground cable) connections in the context of the Ballyadam site only.

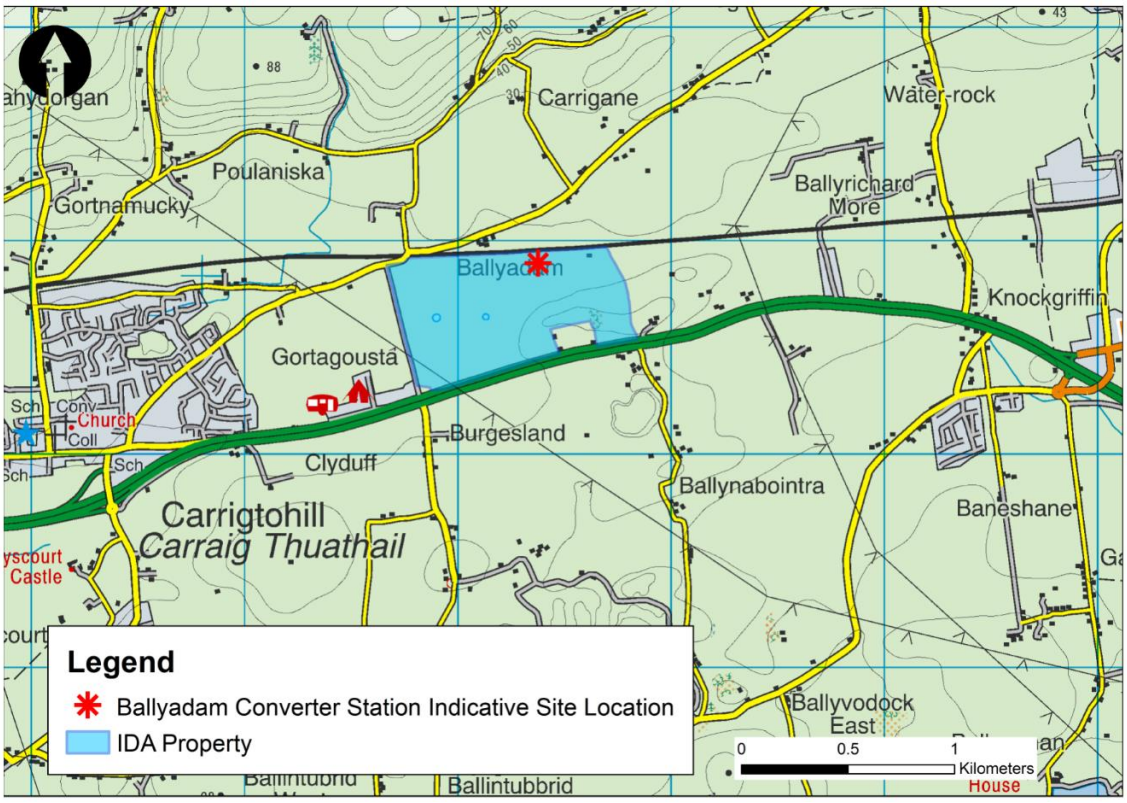
Table 2.1 presents an indication of the measures that will likely be required to be taken to reduce some of the risks identified in relation to the Ballyadam site.

Table 2.1: Proposed Mitigation Strategy

Criteria	Proposed Mitigation Strategy
Karst Features /Drainage	• To avoid impacting on the sensitive karst rock at the site, all surfaces and new roads on site would be proposed to be sealed/impermeable • The storm water drainage system would be a fully sealed system (i.e. no infiltration/discharge to ground) and water would be collected for discharge to the public network to the south west corner of the site • Runoff from the site would be restricted to pre-development/greenfield runoff rates
Flood Risk	• To mitigate the risk of flooding offsite the converter station compound will be raised, and compensatory storage will be provided to compensate for the loss of storage from infilling the existing depressions
Biodiversity	• Development of a plant translocation strategy

Figure 2.10 presents the indicative converter station site location that it is currently anticipated will form part of the forthcoming consent application.

Figure 2.10: Proposed Converter Station Site Location (Ballyadam)



Source: Mott MacDonald

3 Identification of the Best Performing Option (HVAC Route)

3.1 Identification of the EBPOs for the HVAC Route

As detailed in Chapter 2 *Identification of the BPO (Converter Station Site)*, **Ballyadam** has been identified as the BPO for the siting of the converter station. The following sections therefore consider the HVAC circuit connection options to Knockraha 220 kV substation in the context of the Ballyadam site only. A description of technical terms used in this chapter is provided in the Notes section of Table 3.1.

There are 3 options for the HVAC connection. These are outlined in more detail below but in summary comprise:

- A 220 kV UGC two cables per phase arrangement;
- A 400 kV UGC;
- A 220 kV double circuit overhead line ‘loop in’ plus a 220 kV single cable per phase UGC.

Given the length of route along relatively narrow local roads, and the need for the cable to cross under the existing live railway line, there are a number of issues associated with a HVAC connection between Ballyadam and Knockraha 220 kV substation.

Given the 700 megawatts (MW) rating of the Celtic Interconnector, this will require a two cable per phase arrangement for a 220 kV option. A single cable per phase option would simply not have sufficient carrying capacity at 220 kV. An alternative circuit option between the converter station and the substation, is a 400 kV single circuit.

Installation of underground 220 kV HVAC two cables per phase arrangement typically requires a trench width in the order of 2m. Both a 400 kV (single circuit) HVAC option and a 220 kV single cable per phase option (required in conjunction with a “loop-in” to an overhead line) require a trench width of approximately 1m.

A circuit of either voltage extending directly between the converter station and Knockraha 220 kV substation, and thereby exclusively serving the Celtic Interconnector, would be known as a “tail” connection, as it would avoid using transmission circuits of the existing transmission grid.

There is currently a 220 kV double circuit overhead line (meaning two circuits carried on a single pylon) which passes over the south-western corner of the overall IDA landholding at Ballyadam. These circuits run between Aghada and Knockraha 220 kV substations. A possible option for the HVAC connection to Knockraha 220 kV substation is to connect into these existing circuits via a new GIS (gas insulated switchgear) substation at Ballyadam, five new overhead line pylons and new lengths of underground cable between these new pylons and the new GIS substation. In addition, as noted above, a new 220 kV single cable per phase underground cable would need to be installed between the new GIS substation and Knockraha 220 kV station.

This is termed in this report as the overhead line (OHL) “loop-in” option. A potential connection to the existing double circuit 220 kV OHL (“OHL loop-in") and connection via a “tail” underground cable (UGC) are the two options considered for the HVAC connection, as follows:

- Option 1 OHL Loop-in
  - 220 kV UGC single cable per phase, combined with a 220 kV OHL loop in
  - This option would thereby comprise a combination of a loop-in to an existing overhead transmission line (with additional transmission pylons) and underground cable (UGC)
- Option 2 Underground Cable Tail
  - 220 kV two cables per phase arrangement
  - 400 kV single cable per phase

    This option would comprise UGC only.

Table 3.1 presents a summary of the new HVAC infrastructure required for each option assessed and a glossary of terms.

3.1.1 HVAC Option 1 – OHL Loop-in

This option would comprise a combination of OHL loop-in and UGC.

The loop-in into Ballyadam of the existing 220 kV double OHL (Aghada – Knockraha 1 & 2), which passes to the south west section of the Ballyadam site (in the townland of Gortagousta) would require the following additional infrastructure:

- A new 220 kV Gas Insulated Switchgear (GIS) substation building
- Two 220 kV double circuit tension pylons
- Four 220 kV single circuit OHL / Cable interface pylons
- Four new 220 kV cable circuits (as there will need to be a cable coming in and out of each circuit) from the OHL / Cable interface pylon into the new GIS substation
- A 220 kV underground cable from the new GIS substation to the Knockraha 220 kV substation.

This option would allow the 220 kV UGC to be installed in the public road for the majority of the route, however, new equipment in the form of an interbus reactor, would also be required at Ballyadam to balance the power flows between the OHL and the UGC.

The length of the Ballyadam-Knockraha HVAC UGC would be approximately 10km. The trench width would be approximately 1m.

The cable installation would be split into sections, the number of which being determined by the cable length on the cable drum. The length of cable is restricted due to size and weight restrictions for the amount of cable that can be transported on the public roads. Typically, the cable drums come in approximately 750m lengths. and a joint is required to connect the cables therefore every 750m or so. The cable joints would be installed in joint bays, which are typically underground concrete structures, to facilitate cable pulling and jointing. Approximately 14 joint bays are expected to be required for the UGC element of Option 1.

Temporary passing bays would be required in areas where it is not possible to maintain traffic within the existing road alignment during the cable pulling and cable jointing phases. In some instances, temporary local road closures and associated diversions could be required. However, it is anticipated that the existing local road network would be able to provide alternative routeing options such that local and temporary diversions should not cause undue impact.

3.1.2 HVAC Option 2 – Tail-Fed 220 kV Twin Cables per Phase

The 220 kV tail-fed option comprises a new 220 kV Air Insulated Switchgear (AIS) bay and a 220 kV UGC between the converter station site at Ballyadam and the existing Knockraha 220 kV substation.

To achieve the required cable ratings, two cables per phase would need to be provided in a trench approximately 2m in width. This would require two individual joint bays in close proximity at distances of approximately 750m requiring approximately 26 joint bays in total.

As the roads in the area are narrow, it would mean that a significant section of the route would be off the public road for a distance of approximately 2km. The on-road sections are also likely to require full road closures with associated temporary diversions during construction; as per above, it is considered however that this can be adequately accommodated on the local road network of the area.

A new 220 kV shunt reactor would be required at each end of the new 220 kV underground cable circuit, i.e. at Ballyadam and Knockraha, to compensate for the high capacitance associated with the relatively long underground cable. This additional equipment would be located within the converter station and substation compounds and has been previously referred to in respect of the Ballyadam converter station site option at Chapter 2 above.

3.1.3 HVAC Option 2 – Tail-Fed 400 kV Single Cable per Phase

This 400 kV tail-fed option comprises a new 400 kV UGC connection between the converter station site at Ballyadam and the existing Knockraha 220 kV substation.

The converter transformers, AIS equipment and cable sealing ends at Ballyadam would have a voltage of 400 kV instead of 220 kV, as required for the other options. A 400 kV shunt reactor would also be required at Ballyadam to provide reactive compensation for the new 400 kV cable circuit.

A new 400 / 220 kV transformer would also be required at Knockraha 220 kV substation, as well as an associated 400 kV AIS bay, and a 220 kV AIS bay on the existing 220 kV busbar within the station. An area to accommodate this is located at the south eastern portion of the substation (in proximity to the existing substation entrance).

The UGC route would be the same as that of Option 1 requiring a trench width of approximately 1m in width, with potential off-road sections (though significantly fewer than that required for a 220 kV twin cable option) and road closures with temporary diversions onto other roads of the local network in this area.

Table 3.1: HVAC Options (Ballyadam)

	Option 1 OHL Loop In	Option 2 Tail Fed	
Location	**220 kV Single Cable**	**220 kV Twin Cable**	**400 kV Single Cable**
Converter Station Site (Ballyadam)	• New OHL pylons to facilitate an OHL tie-to an existing OHL in proximity to the Ballyadam site – 2 x double circuit 220 kV terminal pylons(one existing double circuit intermediate pylon to be removed) – 4 x single circuit 220 kV line cable interface masts • 4 x 220 kV cables each ca. 1km long • 8 bay (min) 220 kV Gas Insulated Switchgear (GIS) substation • 220 kV Interbus reactor • 220 kV Shunt reactor • 220 kV Harmonic filter	• 220 kV Air Insulated Switchgear (AIS) feeder bay • 220 kV Shunt reactor • 220 kV Harmonic Filter	• 400 kV AIS feeder bay • 400 kV Shunt reactor • 400 kV Harmonic Filter
HVAC Underground Cable Route	• Ca. 10km of 220 kV cable with ca. 14 joint bays • Trench width ca. 1m	• Ca. 10km of 220 kV cable (ca. 2km of which would be required to be installed off road) with ca. 26 joint bays • Trench width ca. 2m	• Ca. 10km of 400 kV cable with ca. 14 joint bays • Trench width ca. 1m
Connection Point (Knockraha Substation)	• 220 kV AIS bay to be equipped at the existing substation, similar to existing infrastructure • 220 kV Shunt reactor	• 220 kV AIS bay to be equipped at the existing substation, similar to existing infrastructure • 220 kV Shunt reactor	• 220 kV AIS bay to be equipped at the existing substation, similar to existing infrastructure • A new 400/220 kV transformer • 400 kV AIS bay, within the existing substation

Notes:

- Air Insulated Switchgear - This is high voltage electrical equipment which uses the open air as its insulating medium. Live conductors are typically mounted outdoors on porcelain insulators on steel supports. Air insulated switchgear has a larger footprint than gas insulated alternatives.
- Gas Insulated Switchgear - This is high voltage electrical equipment which uses gas as its insulating medium. Live conductors are contained in gas filled metal enclosures which are then housed in a building. Gas insulated switchgear has a smaller footprint than air insulated alternatives.
- Harmonic filter - The harmonic filter is a high voltage electrical device which is used to filter out unwanted voltage or current signals at high frequencies. The harmonic filter comprises high voltage electrical equipment which is installed on steel supports outdoors in the open air.
- Interbus reactor- The interbus reactor is a high voltage electrical device which is used to increase electrical impedance of a circuit. It typically comprises insulated copper windings housed in a metal enclosure.
- Shunt reactor - The shunt reactor is a high voltage electrical device used to compensate for the capacitance of the cable circuit. It typically comprises air/epoxy insulated copper windings arranged in a cylindrical shape for each of the three phases.
- Reactive compensation - This is the process of introducing additional reactance to a circuit to counterbalance the capacitance that is present. This allows the electrical characteristics to be optimised to suit the system ratings and comply with grid code requirements.

3.2 Identification of the BPOs for the HVAC Route

The following sections provide an analysis of the options detailed in Table 3.1 against EirGrid's Assessment Criteria as presented in Figure 2.2. For clarity, the loop-in option is being compared with the tail option. While there is some commentary regarding distinction between the 220 kV two cables per phase option and the 400 kV option, this report does not seek to present any overall conclusion between these two tail options.

3.2.1 Environmental Performance

HVAC OHL Loop-in Option 1

The OHL loop-in option would result in a net increase of five new transmission pylons in and adjacent to the south west portion of the overall IDA landholding at Ballyadam, as outlined below;

- Two new double circuit 220 kV terminal pylons
  - one existing double circuit intermediate pylon would be removed but the terminal pylon would be larger in scale than the existing intermediate pylon to be removed
- Four new single circuit 220 kV OHL / Cable interface masts

A new Gas Insulated Switchgear (GIS) transmission substation required to facilitate the OHL loop-in option would significantly increase the land take required for the converter station compound at Ballyadam.

The minimisation of land take is a stated concern of the IDA, having regard to its statutory remit to facilitate industrial and employment generating development on its land banks. The provision of a substation, in combination with the additional transmission pylons, and a corridor of up to 25m width for the four separate UGCs between the converter station/substation site and the area of the loop-in at the south-western corner of the overall landholding, will require a significant additional land take beyond what is required for the converter station itself.

This option also requires the installation of a 220 kV single cable between Ballyadam and the connection point at Knockraha. The majority of this cable route would be in the road which would require road closures and diversions during the installation phase. There could be sections of the cable route which would be off road, such as at some joint bay locations, and in this case, there could be a resulting loss of trees, and other vegetation, to facilitate cable installation.

The OHL loop-in option is least preferred in terms of environmental performance due to the permanent above ground infrastructure that would be required to facilitate the development (including new larger pylons), the increased footprint at Ballyadam to accommodate a substation and likely visual and other impacts given its proximity to sensitive receptors. This is in addition to any environmental impact likely to arise with the laying of an underground cable along or adjacent to the local road network.

HVAC Tail-Fed Option 2

The tail fed options would have a reduced converter station compound footprint, when compared with the OHL loop-in option, given the absence of a transmission substation, as well as the associated cable corridor and large loop-in pylon structures.

The majority of the 400 kV option would be constructed in the road while the two cables per phase arrangement 220 kV option would require more off-road routing given its wider trench requirement. Longer trench installation times and road closures would be required for the 220

kV option; however, this is expected to be offset by the fact that more of the installation works for this option would be off road.

Due to cross-country routing requirements, more hedgerow removal and more drain crossings would be required to facilitate the 220 kV option when compared with the 400 kV option. As the majority of the 400 kV option would be constructed in the road it would be preferred from a cultural heritage perspective.

3.2.2 Social Performance

HVAC OHL Loop-in Option 1

The OHL loop-in option is least preferred in terms of social performance due to the permanent infrastructure that would be required to facilitate the development, in particular in the context of proximity to sensitive receptors to the south west of the Ballyadam site, potential noise implications associated with the interbus reactor and shunt reactors and visual impacts associated with the new 220 kV pylons and GIS substation.

There would also be traffic impacts on local communities during the cable laying works, due to road closures and diversions.

In addition, as noted in Chapter 2 above, the overall IDA landholding at Ballyadam, as well as the N25 at the southern and south-western boundaries of the site, and other currently undeveloped lands to the west and north-west of the overall landholding, are all planned for major future residential, industrial and infrastructure development. The loop-in options, given its scale and extent, could impact upon the sustainable development of these areas.

HVAC Tail-Fed Option 2

The tail fed options perform better than the OHL loop-in option from a social perspective.

Traffic impacts associated with the 220 kV option would be greater than for the 400 kV option as this would require the roadway to be closed for a longer period of time during installation.

The 400 kV option would necessitate the addition of a new transformer at Knockraha substation, while the 220 kV option would require a shunt reactor – both relatively large pieces of noise emitting electrical equipment, although fully contained within the existing substation compound for which there are noise impact mitigation measures available which can be implemented as part of the design solution.

Cross country routing would result in short-term visual impacts during construction but in general there would be little difference between the visual impacts associated with the 220 kV and 400 kV tail-fed options.

3.2.3 Technical Performance

HVAC OHL Loop-in Option 1

The loop-in option does not perform as well as the other options because of the additional maintenance requirements and reliability risks associated with the significant additional HVAC infrastructure including new pylons, line cable interface pylons, multiple cable circuits and a power flow control system comprising an interbus reactor. The loop-in integrates the new 220 kV GIS for the Celtic Interconnector Project as part of a meshed transmission connection.

In addition, the design of the power control equipment would require detailed studies and assessment which would also need to consider the existing generation at Aghada and which may ultimately result in technical and/or operational restrictions being imposed on the Celtic Interconnector under certain system conditions and power flow levels. In addition to this, outages (switching out the circuits so that they are not live) would be required to facilitate the loop-in – this would be made even more lengthy if the loop-in required any associated upgrading of the circuit infrastructure.

HVAC Tail-Fed Option 2

The tail fed options perform similarly when assessed for technical performance. The 220 kV option has twice the length of cable as the 400 kV option and therefore a relatively higher risk of potential cable failure. However, both tail fed options have the advantage that they do not integrate the Celtic Interconnector Project as part of a meshed transmission connection.

3.2.4 Deliverability

HVAC OHL Loop-in Option 1

In terms of design complexity, the loop-in performed poorly when compared to the other options. Firstly, this option requires significant new HVAC infrastructure including a double circuit loop in of the existing Knockraha to Aghada 220 kV double circuit overhead line, new line cable interface masts, multiple underground cable circuits and a new 220 kV GIS substation and associated additional civil works.

For the OHL option, the new 220 kV GIS substation at Ballyadam would effectively become the connection point for the Celtic Interconnector. The new cable from Ballyadam to Knockraha would then form part of the transmission network, instead of being a less complex interconnector tail fed feeder. There would therefore be a requirement to carefully control power flows between the OHLs and UGC feeder. This would be achieved by a new interbus reactor to be installed at Ballyadam on the underground circuit. The design of this would be complex requiring detailed studies and assessment which would also need to consider implications in relation to the generation at Aghada.

The loop-in option does not perform as well as the tail fed option, in terms of dependence on other infrastructure because more extensive outages would be required to loop in the double circuit OHL and to commission the new GIS substation. Also, the OHL works, UGC loop-in and the GIS substation may result in interaction / encroachment with the N25 interchange and other future potential IDA development at Ballyadam.

In relation to impacts to landholdings, the loop-in benefits from a narrower trench and therefore less requirement to be routed off road through private/third party lands, however new OHL loop-in pylons and cables would be required on private lands.

HVAC Tail-Fed Option 2

The design for the tail fed options would be less complex as the Celtic Interconnector would be connected directly into Knockraha in a comparatively simpler tail connected configuration with less new HVAC infrastructure required.

The local traffic disturbance impact would be higher for the tail fed 220 kV twin cables per phase option as this would require the roadway to be closed for a longer period of time during installation. This is despite the fact that there will be less cable installation in the roadway which

has approximately 8km in the road compared with nearly 10km in the road for the other two options.

In relation to impacts to landholdings, the 400 kV option performs best because of the reduced off-road requirements. The tail fed 220 kV twin cables option does not perform as well as the other two options as significantly more of this is required to be routed off road given the wider trench required. There is an increased cable route length and associated increase to the number of joint bays which will need to be accommodated in private / third party lands.

3.2.5 Economic Performance

The OHL loop-in option including the provision of a 220 kV single circuit underground cable is more expensive than the tail-fed options. Moreover, this does not take into account any potential uprating of the existing OHL that might be required to facilitate the carrying of higher electrical load than currently occurs.

3.2.6 Conclusion (HVAC OHL Loop-in and Tail-Fed Options)

The evaluation of the OHL loop-in connection option set out in the previous sections has focused on works that would be required in the south west of Ballyadam to specifically facilitate the loop-in itself, as well as the provision of an underground 220 kV single circuit cable between Ballyadam and Knockraha substation (including necessary works within the substation itself). It should be noted however that further uprate works to the remaining sections of the existing OHL may also be required to facilitate Option 1.

Even without consideration of uprate works to the existing OHL, the HVAC OHL loop-in option does not perform well when compared to the tail-fed options in terms of environmental, social technical, deliverability and economic performance.

The **HVAC tail-fed option** has therefore been identified as the BPO for the HVAC land circuit connection. Further technical, environmental and other assessments will be undertaken to determine which of these options (220 kV two cables per phase or 400 kV single circuit) will be brought forward for consenting. This will occur in engagement with relevant stakeholders, communities and landowners.

4 Identification of the Best Performing Option (Landfall Location and HVDC Route)

4.1 Identification of the BPO for the Landfall Location

Claycastle Beach offers the best performing marine approach route to make landfall for the submarine cables as it follows a sediment channel with sufficient depth to bury the cable to the required depth for protection against fishing and shipping without the requirement for rock cutting or external protection (by way of rock placement). Avoidance of rock cutting and other permanent disruption to the seabed is beneficial in terms of environmental considerations and also ensures a reduction in construction noise both above and below water.

The identified Claycastle Beach landfall is located approximately 2km south west of the town of Youghal in the vicinity of the Claycastle Beach car park. The HVDC land circuit described below will terminate at a transition joint bay to the north-west of the car park at Claycastle Beach. The submarine HVDC cable between Ireland and France will connect with the onshore HVDC cable at this point. The landfall is formed by a gently sloping sandy beach and the offshore cable is routed for approximately 34km within the Irish Territorial Waters.

Social impacts (albeit temporary) associated with the installation of the cable at Claycastle Beach (for example in respect of local amenity and tourism, and fishing) could largely be avoided with the implementation of standard construction phase mitigation such as timing of works and the implementation of an effective Construction Environmental Management Plan (CEMP) and Traffic Management Plan (TMP).

It is consequently determined that **Claycastle Beach** is the BPO landfall location, particularly as it offers the least constrained offshore approach, and a relatively good road network for the HVDC cable connection to the Ballyadam site when compared to the other landfall location options considered (as addressed in previous reports).

4.2 Identification of the EBPOs for the HVDC Route

The following sections provide further detail on HVDC route options and has been informed by discussions with Transport Infrastructure Ireland (TII) and Cork County Council regarding avoidance of prospective upgrades of the N25 and dual carriageways and alternatives to the main thoroughfares of Castlemartyr and Killeagh. Both Horizontal Directional Drilling (HDD) and open cut are currently being assessed for identified water crossings.

4.2.1 Midleton

As noted in Section 2.3.1, the N25 National Road between Carrigtwohilll and Midleton is planned for significant upgrading, including widening to full dual carriageway status, and provision of a new or modified interchange in the vicinity of the Ballyadam landholding.

This major infrastructure project is currently the subject of public consultation, and no specific plans for the road scheme have been published. This results in an unacceptable level of uncertainty for the Celtic Interconnector Project with regard to the locations for laying of the

underground HVDC cable. As such, the option to route the HVDC cable along the N25 West of Midleton is not being pursued.

Bringing the cable off the N25 at Midleton was considered to unduly impact on this large town - particularly in terms of traffic, disturbance, conflict with existing services, for no meaningful benefit in comparison with use of an alternative local road route.

Consequently, the proposed HVDC route will follow a local road route north of Midleton, extending north and north-westwards off the N25 at Churchtown (Two Mile Inn). While this inevitably adds additional length to the HVDC cable (approximately 4km), this is offset by avoiding the uncertainty for delivering the Celtic Interconnector Strategic Infrastructure Project that would otherwise arise with seeking to lay the cable further westwards along the N25 to Ballyadam.

4.2.2 Greenway (Midleton to Youghal disused railway)

As detailed in the Step 4A Consultant's Development Options Report (Mott MacDonald, November 2019), the Greenway along the disused Midleton to Youghal railway line has been developed by Cork County Council based on the ownership of the alignment remaining with Iarnród Éireann. The duration of the lease is likely to be of the order or 15-20 years. The design life of a circuit such as the Celtic Interconnector is in the order of 40-60 years.

This presents a number of issues for access in case of a fault or maintenance, potential for damage during railway construction, and the consequent potential requirement to establish a new cable route for the Interconnector should the railway be reopened.

Work has now commenced on the Greenway project with the clearance of vegetation and obsolete railway sleepers. The Greenway is expected to be complete and operational as a regional tourism resource by the end of 2022, some years prior to construction of the onshore HVDC cable, and indeed completion of the Celtic Interconnector project.

While engagement is ongoing with the Cork County Council Greenway development team in terms of crossings of the Greenway by the HVDC cable at a number of locations along its route, it remains the case that the Greenway is not of itself a viable option for routing the HVDC land circuit of the Celtic Interconnector.

4.2.3 Castlemartyr and Killeagh

Routing a HVDC cable circuit through Castlemartyr presents particular issues, as outlined below:

- Castlemartyr is an Architectural Conservation Area (ACA). The route would need to cross the Kiltha River at the Kiltha River Bridge in Castlemartyr which is a stone bridge and listed on the National Inventory of Architectural Heritage (NIAH). The road surface on the bridge is too shallow to install the cable route with sufficient cover over the bridge.
  - Navigating the bridge is more difficult given the parallel underground utilities at Castlemartyr as well as crossings of underground services
- The Castlemartyr Forest Bridge is also a stone bridge on the N25 with insufficient cover for installation of the trench. In this situation, crossing the river would require HDD which may be complex given the density of vegetation and apparent depth and width of the water crossing.

There are also issues associated with routing a HVDC cable circuit through Killeagh, as set out below:

- Killeagh is a medieval village and conservation area with a high archaeological potential. Bridge crossings are also listed on the NIAH;
- The route would need to cross the Dissour River at the Killeagh River Bridge in Killeagh. The road surface on the bridge is too shallow to install the cable route with sufficient cover over the bridge. Further, the height of the bridge and road surface above the river combined with the bend of the N25 at this point means that HDD at this point would be challenging;
- There are numerous parallel underground utilities at Killeagh as well as crossings of underground services;
- The road in Killeagh has recently been re-surfaced;
- The Killeagh Railway bridge would need to be crossed but it has insufficient cover to install the cable to the appropriate depth; and
- The Ballymakeagh More Bridge has insufficient cover to accommodate the trench, and as such, an off road crossing of the water course would be required. The width of the water course may allow for a culvert, failing which, HDD would likely be required.

In particular respect of the fourth bullet point above, in addition to new off-road bridge crossings being required in Killeagh and Castlemartyr, it is also noted that both villages have undergone urban improvement works over the last number of years, with resulting construction impacts for the receiving communities.

Notwithstanding that the laying of the HVDC cable along or in the vicinity of the main streets of Killeagh and Castlemartyr remains feasible, it is the case that cross-country diversions around Castlemartyr and Killeagh are also being identified and assessed.

4.2.4 Ballyvergan Marsh

Due to structural constraints associated with a bridge in the area it will be necessary to traverse the very eastern edge of Ballyvergan Marsh proposed Natural Heritage Area (Site Code 000078), in proximity to the bridge for a section of up to approximately 200m in length. This includes the crossing of the Midleton-Youghal Greenway which also occurs in this location.

4.3 Identification of the BPO for the HVDC Route

The **HVDC Underground Cable** connection between Ballyadam and Claycastle Beach will follow a local road route north of Ballyadam and north of Midleton to Churchtown and along the N25 via Castlemartyr and Killeagh and onwards to Claycastle Beach. Due to a number of constraints along these routes, local cross-country options bypassing Killeagh and Castlemartyr are also to be brought forward for further consideration and assessment.

5 Conclusions and Next Steps

5.1 Conclusion

It is EirGrid's intention to progress to Step 5 (the planning process) for the development of the Irish elements of the Celtic Interconnector project based on the following:

- A submarine circuit landfall at Claycastle Beach in Youghal, County Cork connecting approximately 497km of submarine cable between France and Ireland;
- A landfall point where the submarine circuit will come onshore and terminate at a transition joint bay to the north-west of the car park at Claycastle Beach, also potentially including an associated control building;
- An underground HVDC land circuit between the landfall point at Claycastle Beach and the converter station compound at Ballyadam, east of Carrigtwohill;
- A converter station compound at Ballyadam to convert the electricity from HVDC to HVAC and vice versa;
- An underground HVAC land circuit between Ballyadam and the connection point to the grid (Knockraha substation); and
- A connection to the transmission grid within Knockraha substation in County Cork.

A fibre optic cable is also planned to be laid along the entire route for operational control, communication and telemetry purposes. Given that this cable will be included within the overall HVDC cable infrastructure, it has not been addressed separately in this report.

Table 5.1 presents a summary of the townlands within which the Best Performing Option is identified. These are also presented in Appendix B of this report which contains indicative mapping of the Best Performing Option.

It should be noted though that this identified BPO is subject to change as studies and assessments are ongoing and additional localised cross-country routing may be required at to avoid certain constraints, however, it will form the basis for ongoing design and assessment up to presentation of a proposal for consenting, as detailed in Section 5.2.

Table 5.1: Townlands of the Best Performing Option

Townlands of the Best Performing Option
Knockraha Substation (Ballynanelagh)
Knockraha Substation (Ballynanelagh) to east of Ballynanleagh (Killeena)
East of Ballynanleagh, west of T-Junction (Killeena) to East of Ballynanleagh, east of T-Junction (Killeena) – in road
East of Ballynanleagh, west of T-Junction (Killeena) to East of Ballynanleagh, east of T-Junction (Killeena) – off road
East of Ballynanleagh, east of T-Junction (Killeena) to Garranes crossroads (Garranes)
Garranes crossroads (Garranes) to south of Woodstock (Woodstock)
Woodstock (Woodstock)/Gortnamucky to north of Ballyadam (Ballyadam)
Woodstock (Woo)/Woodstock to north of Ballyadam (Ballyadam)
Woodstock (Woodstock north of Ballyadam (Ballyadam) parallel to railway line
Woodstock (Woodstock)/ to of Ballyadam (Ballyadam) partially parallel to railway line
North of Ballyadam (Ballyadam) to Ballyadam (Ballyadam)
Ballyadam (Ballyadam)

Townlands of the Best Performing Option
Ballyadam (Ballyadam) to Carrigogna/R626 (Carrigogna)
Carrigogna (Carrigogna) to Ballyspillane East (Ballyspillane East)
Ballyspillane East (Ballyspillane East) to Roxborough (Roxborough)
Roxborough (Roxborough) to Churchtown North/N25 (Ballyedekin)
Churchtown North (Ballyedekin) to West of Castlemartyr (Killamucky)
West of Castlemartyr (Killamucky) to East of Castlemartyr (Clasharinka) in road
West of Castlemartyr (Killamucky) to East of Castlemartyr (Clasharinka) – off road
East of Castlemartyr (Clasharinka) to West of Killeagh (Mountbell)
West of Killeagh (Mountbell) to east of Killeagh (Ballymakeagh More) – in road
west of Killeagh (Mountbell) to east of Killeagh (Ballymakeagh More) – off road
Killeagh (Ballymakeagh More) to N25/west of R634 (Ballyvergan West)
Ballyvergan West (Ballyvergan West) to R634/ R908 (Summerfield)
R634/ R908 (Summerfield) to north of Claycastle Beach car park (Summerfield)
Transition Joint Bay (Summerfield) to HW mark at Claycastle Beach (Summerfield)

5.2 Next Steps

An application for statutory approval to the Strategic Infrastructure Development (SID) Division of An Bord Pleanála (ABP) and a Foreshore Licence Application to the Foreshore Unit of the Department of Housing, Local Government and Heritage (DHLGH) will now be prepared for the BPOs identified in this report.

The application to ABP will relate to works between Knockraha substation and the ordinary high water mark at Claycastle Beach.

The application to the Foreshore Unit of the DHLGH will relate to works between the ordinary high water mark at Claycastle Beach and the twelve nautical miles limit (twelve nautical miles is appropriately 22.24km).

Both applications will be supported by an Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement (NIS).

It is anticipated that the applications will be submitted in Spring 2021.

A. References

The following documents are available to view on EirGrid's Project website:

https://www.eirgridgroup.com/the-grid/projects/celtic-interconnector/related-documents/index.xml

- Step 3 Onshore Constraints Report (Mott MacDonald, April 2019)
- Step 3 - Performance Matrix Assessments (EirGrid, Spring 2019)
- Step 4 Consultation Report (Traverse, April 2020)
- Step 3 Preferred Options Report (Mott MacDonald, August 2019)
- Step 4A Consultant's Development Options Report (Mott MacDonald, November 2019)
- Step 4 Project Update Document (EirGrid, Spring 2020).

The N25 Brochure is available to view at:

https://www.n25carrigtohillmidleton.ie/wp-content/uploads/2020/10/N25-Brochure.pdf

B. Best Performing Options (Indicative Mapping)

Watergrasshill
Lisgoold
Dungourney
Knockraha
Sheet 1
Sheet 2
Sheet 3
Sheet 4
Killeagh
Youghal
Mogeely
Midleton
Churchtown
Castlemartyr
Carrigtwohill
Cobh
GREAT ISLAND
An tOileán Mór
CORK HARBOUR
Cuan Chorcaí
CELTIC SEA
W
X
Youghal Bay
Cuan Eochaille
Ballycotton Bay
Bá Bhaile Choitín

Location Map

Key to Symbols

- Towns
- Connection Point Knockraha
- Converter Station Site Location (CSS1)
- Landfall Point
- High Voltage Alternating Current (HVAC) Underground Cable
- High Voltage Direct Current (HVDC) Underground Cable
- HVDC Underground Cable - Route to be Agreed
- Off-Road Works Under Consideration
- Off-Road Works Under Consideration - Route to be Agreed
- Offshore Cable Route

Notes

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Celtic Interconnector Step 4B Report
Best Performing Options

Grid Index Map

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GIS Check	P Chambers		Approved	D Hasset	

Scale at A3	Status	Rev	Security
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Drawing Number
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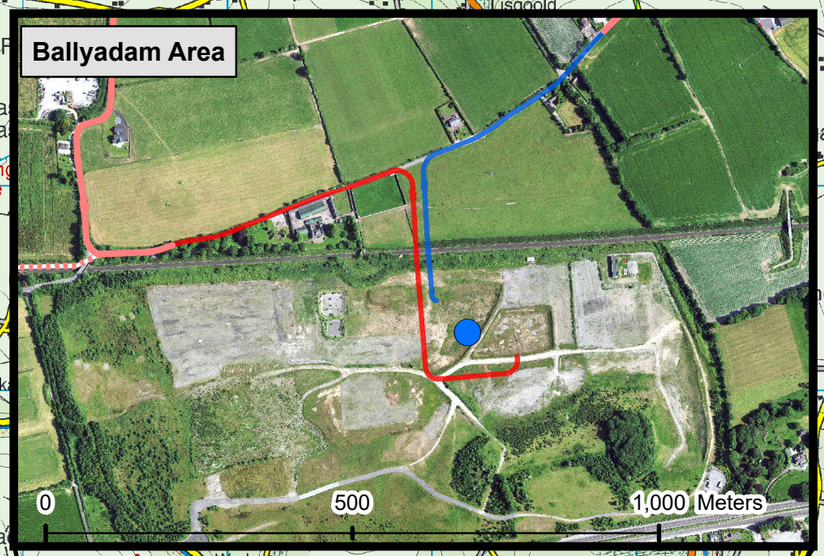
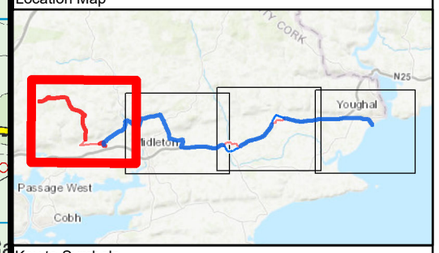


Location Map



Key to Symbols

- Connection Point Knockraha
- Converter Station Site Location (CSS1)
- High Voltage Alternating Current (HVAC) Underground Cable
- High Voltage Direct Current (HVDC) Underground Cable
- Off-Road Works Under Consideration
- Off-Road Works Under Consideration - Route to be Agreed

0 Metres 1,000

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Sheet 1 of 4

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GIS Check	P Chambers		Approved	D Hasset	

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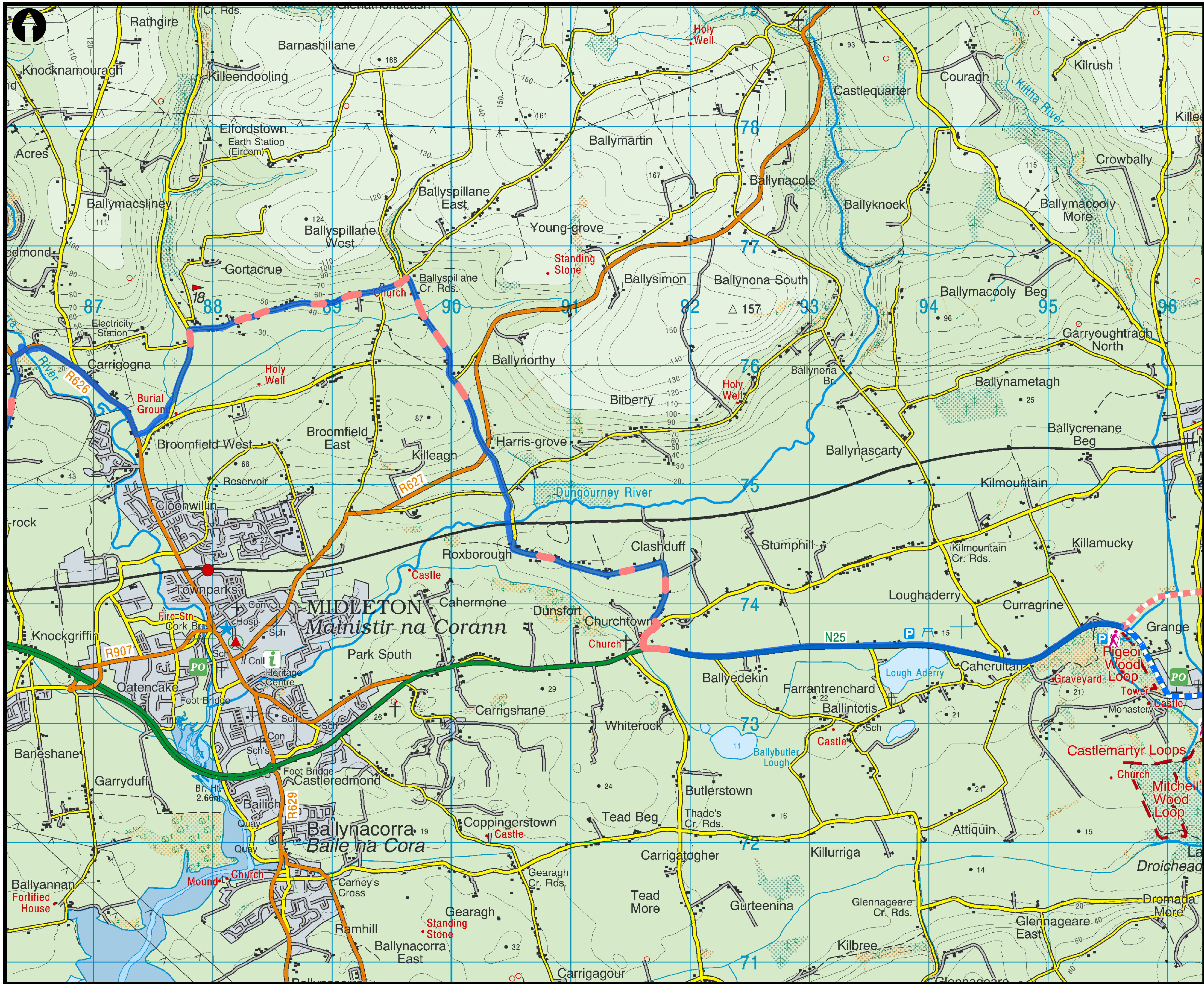

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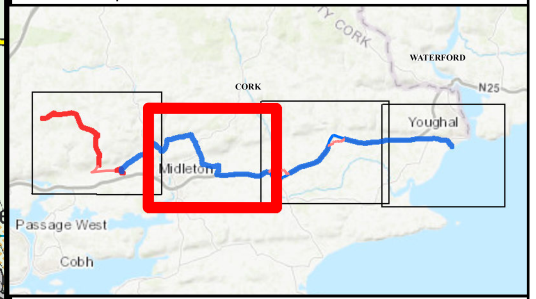

Key to Symbols

- High Voltage Direct Current (HVDC) Underground Cable
- HVDC Underground Cable - Route to be Agreed
- Off-Road Works Under Consideration
- Off-Road Works Under Consideration - Route to be Agreed

0 — 1,000 Metres

Notes

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Celtic Interconnector Step 4B Report Best Performing Options
Sheet 2 of 4

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GIS Check	P Chambers	Approved	D Hasset

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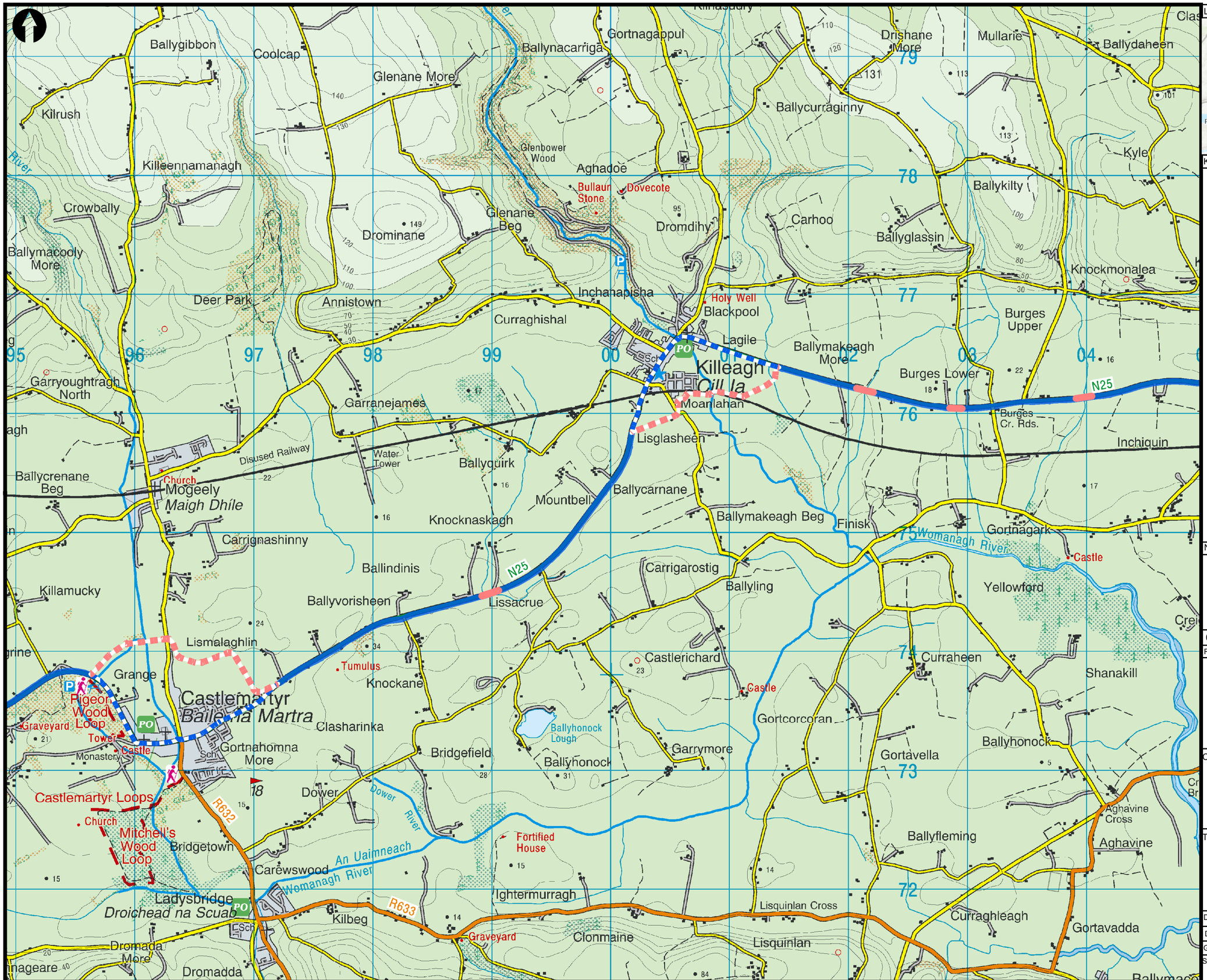

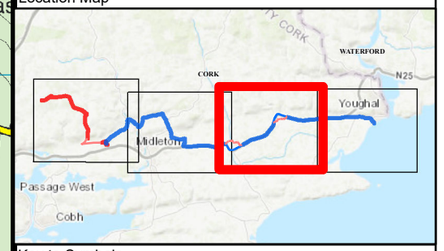

Key to Symbols

- High Voltage Direct Current (HVDC) Underground Cable
- HVDC Underground Cable - Route to be Agreed
- Off-Road Works Under Consideration
- Off-Road Works Under Consideration - Route to be Agreed

0 Metres 1,000

Notes

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Sheet 3 of 4

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GIS Check	P Chambers		Approved	D Hasset	

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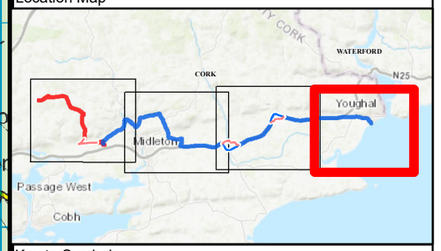
Location Map



Key to Symbols

- Landfall Point
- High Voltage Direct Current (HVDC) Underground Cable
- Off-Road Works Under Consideration
- Offshore Cable Route

0 — 1,000 Metres

Notes

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Sheet 4 of 4

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GIS Check	P Chambers		Approved	D Hasset	

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